Suture anchor selection

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I. Introduction

History

- Du Toit & Roux (1956): Johannesburg stapling technique
- Dr. LL Johnson

Clinical applications of suture anchors in shoulder surgery

Principally for the fixation of tendons of ligaments to bone

- Glenohumeral instability
- Rotator cuff repair
- SLAP lesion repair
- Biceps tenodesis
- Hand, elbow, knee, foot surgery

Advantages

- less exposure(arthroscopic)
- standardized load to failure properties
- better holding strength
- ease of insertion
- multiple sutures

Disadvantages

- increased costs (anchors and instruments)
- extra instrumentation
- learning curve to master
- consider "Deadman s" angle

Desirable features (Ideal Implant)

- easy to implant
- excellent pullout strength
- prevent suture abrasion
- does not "complicate" subsequent surgery
- will be bioabsorbable with no reaction from the patient as the material dissolves.

II. Biomechanical considerations in suture anchor design

- anchor pullout strength
- suture tensile strength
- anchor-suture interface

III. Implant size considerations

- must be large enough to have adequate load strength
- must be small enough to fit in the space without the tendency to come loose or damage the adjacent structures
- larger anchors are better suited for the cuff repair, smaller anchors are better for the Bankart and SLAP repairs
- (3.5 mm to 4.1 mm diameter in the maximum size for labral repair)
- Ideally, the smallest implant of sufficient strength to obtain the most stable fixation for soft-tissue healing will allow not only multiple fixation points but also minimizing articular surface compromise and maximize restoration of the normal anatomy.

IV. Implant design considerations

- anchor pullout strength
- suture-anchor interface (eyelet) design
- anchor material composition
- eyelet design and orientation

V. Suture material considerations

decreased incidence of suture breakage during knot tying, limiting anchor compromise

- strength and ease of sliding for knot tying
- knot durability related to suture slippage (unraveling)
- suture cutout through repaired tissue

VI. Potential benefits of bioabsorbable suture anchors

- greater ease of postoperative imaging
- potential restoration of bone stoke, after resorption
- ease revision surgery

VII. Knotless suture-based anchors

- Require familiarity with their use
- Provide secure suture fixation of soft tissue to bone
- Do not require knot tying
- Provide a no-profile or low-profile repair without requiring a nonsuture component of the anchor to remain intraarticular
- Suture-first technique vs. through-tissue technique

VIII. Sutureless anchors in shoulder surgery

- Bankart stabilization & rotator cuff surgery
- Simplicity of their insertion
- Overall sucess is inferior to that of suture anchors
- Possibly significant complications (inflammatory reactions, intraarticular migration, failure reduction)

IX. Potential sources of anchor failure

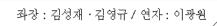
Goradia: - Bioabsorbable tacks/metal suture anchors/transosseous sutures

- cyclic loading, cadaver model
- No. of cycles to 100% failure: tack group >> transosseous group

Cummins: - Sheep rotator cuff model

- Bioabsorbable tacks/Mitek rotator cuff Quick Anchors
- Inferior initial load properties in bioabsorbable tacks

Wilkerson: Bioabsorbable tacks used in rotator cuff and labral repairs have been reported to break and back out from tacks s insertion point



Thal: - suture strength

- knotless suture anchor > standard suture anchors

Zumstein - Mitek G II standard metal anchor/Mitek knotless suture anchors

- cadaveric glenoids
- The standard anchor allowed significantly less suture displacement than the knotless anchor, although the ultimate tensile strength and mode of failure were similar.

Failure point of suture anchors

- at the suture-tendon interface
- in the suture substance
- at the suture-anchor interface
- in the anchor itself
- at the anchor-bone interface

Suture materials

Baber: - Biomechanical evaluation of several suture and anchor types

- No.2 Ethibond failed at 92N of load

No.5 193N of load

No.2 Panacryl(Ethicon) 99N of load

No.2, 5, 2-0 Fiberwire (Arthrex) 188N, 483N, 82N of load

- The suture anchors all failed at higher loads than their associated sutures.

Interface between the suture anchors and structure strands

Bardana: - sutures oriented at 45° to the anchor are significantly more prone to abrasion and breakage

- rotation of the suture with respect to the anchor did not significantly affect the abrasion rate of the suture.

Meyer: - increased suture abrasion at 45°

- decreased suture failure load by 73%
- anchor eyelet design may also influence suture abrasion

Anchor mechanical strength: design/material

- Biodegradable polymers, bioabsorbable suture anchors
- PLA(polylactic acid), PGA(polyglycolic acid)
- The time period of mass loss
 - molecular weight of polymer
 - crystallinity

- porosity

- advantage: little artifact generation on MRI

Avoid problems with permanent implants such as during revision

surgery

- disadvantage: more expensive

Increased wear characteristics at eyelet

Biomechanical strength of absorbable and nonabsorbable anchors

Demirhan: 75% loss of initial pullout strength of PGA wedge-type suture

anchors within the first 3 weeks compare with similar

nonabsorbable anchors

Bardana: eyelet failure in bioabsorbable anchors

Dejong: no significant differences

Suture anchor vs transosseous tunnel technique

Reed: suture anchor(in the suture) >> TTT(in the bone)

Burkart: Mitek RC > TTT

Lewis: no differences in healing time, but, anchor > TTT

Must consider: The suture type

Implant design Implant material

X. Technical considerations

Anchor orientation/Implantation patterns/Implant locations

Anchor orientation

Burkart:

- ideal orientation of suture anchors in RC => "Deadman"
- ideal angle between the anchor and pull of the RC should be ≤ 45°

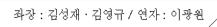
Liporace: in vivo study, similar pullout strength: 30°~90°

Single or Double rows

Double row may reestablish the rotator cuff footprint

- --> may allow for better healing
- --> may restore the biomechanical properties of the healed cuff Woltrip, Demirhan:

Duel site fixation (suture anchor + TTT) > single row or TTT alone



Location: important role in anchor pullout strength

Meyer: BMD below the articular surface and in the GT in FTRCT

<< intact specimens

Baber: GT cadaver (avg. 80yrs)

- posterior area of GT > anterior
- no difference between GT, LT, humeral neck
- no correlation between BMD and suture anchor pullout strength

Tingart et al:

- CT
- total, trabecular, cortical BMD in different regions of the GT & LT
- higher BMD in posterior portion of GT
- clear association between BMD and load to failure

XI. Complications of anchor use

- failure of the tissue, suture, or anchor before healing
- Kaar (Metallic anchors)
 - extraosseous anchor placement
 - anchor migration
 - intraarticular anchor dislodgement with consequent articular damage
 - local foreign body reaction

Bioabsorbable anchors

- Inflammatory reaction

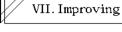
XII. Summary

- 1. Many design features including suture type, anchor size and geometry, and anchor material, play a role in the overall strength of the anchor. In addition, technical considerations such as implant orientation, pattern, and location may affect the ultimate success of the repair.
- 2. Multiple fixation points provide a biomechanically sounder construct in Bankart repair. The size of the glenoid and its rim make anchor size a critical consideration in implant selection and implementation.

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